Laboratory Techniques

Section 1: Safety Information

Reading a chemical label

1. Name of chemical, formula weight, quality, quantity, concentration, etc
2. Hazard Alert
3. Large hazard warning
4. At-a-glance chemical safety guide (0 = low hazard rating, 3 = high hazard rating)
5. Warning information
6. First Aid
7. Rating of chemical "under fire conditions" - meant to help firefighters only
   (0 = low under fire hazard, 4 = high under fire hazard)
   (H = health, F = fire, R = reactivity, bottom box for special codes)
   * this is not a good safety guide for a chemical laboratory - use information given in #4

Reading a Material Safety Data Sheet (MSDS)

Section 1 — Chemical Product and Company Identification

Hydrochloric Acid

Flinn Scientific, Inc. P.O. Box 219 Batavia, IL 60510 (800) 452-1261

CHEMTREC Emergency Phone Number: (800) 424-9300

Section 2 — Composition, Information on Ingredients

Hydrochloric Acid, 36.5-38.0%, concentrated
Synonym: Muriatic acid
CAS#: 7647-01-0

Section 3 — Hazards Identification

Clear liquid; pungent odor; constantly fuming.
Highly toxic by inhalation and ingestion.
Severe corrosive to all body tissues, especially skin and eyes. Avoid all body contact.

FLINN AT-A-GLANCE
Health-3
Flammability-0
Reactivity-2
Exposure-3
Storage-3

0 is low hazard, 3 is high hazard

Section 4 — First Aid Measures

Call a physician, seek medical attention for further treatment, observation and support after first aid.
Inhalation: Remove to fresh air at once. If breathing has stopped give artificial respiration immediately.
Eye: Immediately flush with fresh water for 15 minutes.
External: Wash continuously with fresh water for 15 minutes.
Internal: Give 1 to 2 cups of water or milk, followed by a gastric antacid, such as milk of magnesia. Do not induce vomiting. Call a physician or poison control at once.

Section 5 — Fire Fighting Measures

Non flammable liquid.
When heated to decomposition, emits toxic fumes of Cl.
Fire Fighting Instructions: Use triclass, dry chemical fire extinguisher. Firefighters should wear PPE and SCBA with full facepiece operated in positive pressure mode.

NFPA CODE
None Established

Section 6 — Accidental Release Measures

Restrict unprotected personnel from area. Remove all ignition sources and ventilate area. Contain spill with sand and absorbent material, neutralize with sodium bicarbonate or calcium hydroxide and deposit in sealed bag or container. See Sections 8 and 13 for further information.

Section 7 — Handling and Storage

Flinn Suggested Chemical Storage Pattern: Inorganic #9. Store with inorganic acids.
Store in a dedicated acid cabinet and away from any source of water; if an acid cabinet is not available, store in Flinn Saf-Cube.
Use and dispense in a hood.

Section 8 — Exposure Controls , Personal Protection

Avoid contact with eyes, skin and clothing. Wear chemical splash goggles, chemical-resistant gloves and chemical-resistant apron. Use ventilation to keep airborne concentrations below exposure limits. Always wear a NIOSH-approved respirator with proper cartridges or a positive pressure, air-supplied respirator when handling this material in emergency situations (spill or fire).
Exposure guidelines: TWA 5 ppm (OSHA)

Section 9 — Physical and Chemical Properties

Clear liquid; pungent odor; constantly fuming.
Solubility: Soluble in water, alcohol and benzene.
Formula: HCl
Formula Weight: 36.46

Specific Gravity: 1.2

Section 10 — Stability and Reactivity

Avoid contact with strong oxidizers, bases, amines, alkali metals, copper, copper alloys, aluminum. Corrodes steel and reacts violently with water.
Shelf Life: Good, if stored safely.

Section 11 — Toxicological Information

Acute effects: Poison, corrosive
Chronic effects: N.A.
Target organs: N.A.

ORL-RBT LD50: 900 mg/kg
IHL-RAT LC50: 3124 ppm/1H
SKN-RBT LD50: N.A.

N.A. = Not available, not all health aspects of this substance have been fully investigated.

Section 12 — Ecological Information

Data not yet available.

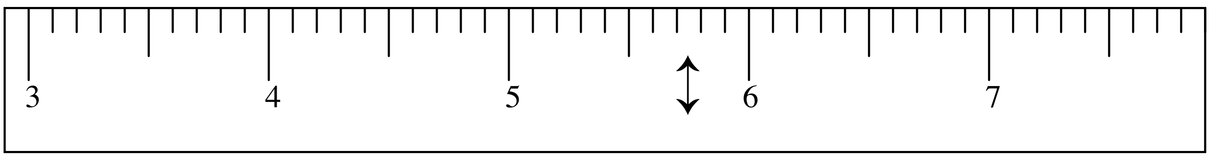
Section 13 — Disposal Considerations

Please consult with state and local regulations.
Flinn Suggested Disposal Method #24b is one option.

Using the above sample label and MSDS, answer the questions in Section 1 of the Assignment Sheet (at the end of this packet).

Section 2: Making Measurements
Measurements are made using equipment that contain equally spaced markings. Each marking is representative of a certain amount, but there is usually space in-between the markings. It is your job as a scientist to estimate the amount seen between the markings, using this as the last digit in your measured number. This is the digit with the "uncertainty". Never estimate more than one digit.

For example



An object measured using this metric ruler ends at the arrow above. The numbers represent centimeters, so we know it at least 5 cm long. As there are ten spaces between each numbered line, each space is worth .1 cm. So we know the object is 5.7 cm long. Now we must estimate the final digit, which is somewhere between the .7 and .8 marks. Thus the length to record for this object is 5.74 cm. You may choose any number 1-9 as is appropriate, and it will be understood that this last digit is a guess and thus has some uncertainty.

Find a metric ruler and answer the questions in Section 2 of the Assignment Sheet.

Section 3: Measuring Temperature
For measuring temperature in Chemistry the celsius scale is the most often used. (Kelvins are used only for situations involving confined gases.)

NEVER SHAKE DOWN A THERMOMETER.
The fluid in the thermometer (usually a red colored alcohol) will move easily on it's own.

When taking the temperature of a liquid, do not let the thermometer touch the container, or you will be measuring the temperature of the container, not the liquid. Allow sufficient time for the fluid inside the thermometer to stop moving before reading the fluid level. Not all thermometers measure the same scale, so always check the marks before recording a temperature.

Answer the questions in Section 3 of the Assignment Sheet.

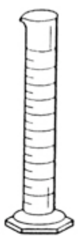
Section 4: Measuring Liquid Volumes
The SI unit for measuring liquids is the Liter, but often this is too big for lab use. Usually milliliters (mL) are used instead. There are many ways to measure liquid volumes, including pipets, graduated cylinders, and beakers. There are advantages and disadvantages to each piece of equipment.

When measuring liquids, a meniscus will form (a dip in the surface level of the liquid.) All liquid measuring equipment (pipets, graduated cylinders, beakers, etc) are DESIGNED to measure accurately to the BOTTOM OF THE MENISCUS.

Pipets:

Pipets are the best way to collect an exact amount of a liquid. Often pipets can only measure one amount (like only 1 mL). Sometimes they have markings for small ranges of amounts (like 0-10 mL). Pipets are not often used, as many different ones would be needed just for one lab.

Pipets will only be discussed further when used in a lab.



Graduated Cylinders:

Graduated cylinders are the best compromise between exactness and usefulness. Graduated cylinders come in many size ranges, thus the space in-between the markings will be different. This is the most common piece of equipment for measuring liquid volumes, as large ranges (like 0-1000 mL) are possible with good accuracy.

Answer questions 1-12 in Section 4 of the Assignment Sheet.

Beakers:

Beakers are more often used simply to hold liquids rather than to measure them. Beakers come in many sizes (like from 25 mL to 2000 mL), but the larger the beaker is the more inexact the beaker is.

Gather a 50 mL and 100 mL graduated cylinder, and a 150 mL, 250 mL, 400 mL, and 600 mL beaker. Answer questions 13-17 in Section 4 of the Assignment Sheet.

<u>Section 5: Measuring Solid Volumes</u>

When the volume of a solid is needed, it is possible to take the length x width x height as long as the sides are straight and the corners are 90°. If the object is of a irregular shape, then measuring with a ruler becomes almost impossible. In this case we can measure the volume by *water displacement*. When an object is placed in water, it moves water out of the way equal to the object's volume. Thus if we calculate how much water got moved, we would be able to know the volume of the solid.

Start with an initial amount of water in a graduated cylinder (record this amount). Gently place in the object, and record the new water level. Note that the object must be completely under the water level for this to work. Subtract the initial level from the final level to get the volume of the object.

To calculate the volume by water displacement:
Final water level - Initial water level = volume of water moved = volume of object

Gather 5 marbles, 10 pennies, 20 paperclips, and a 100 mL graduate cylinder. Answer the questions in Section 5 of the Assignment Sheet.

Section 6: Measuring Mass

Mass is a measure of how much matter is in an object. Weight is a measure of how hard gravity pulls on an object. Mass is usually measured in grams (or pounds in the USA) and weight is measured in newtons. Thus it is technically wrong to tell someone you are 150 pounds if they ask for your weight (your weight would be roughly 720 newtons). Many people talk about weight instead of mass simply because they don't know they are using the wrong word.

Every object on the earth feels the effects of gravity, so to find an object's mass we need to use equipment called balances that will "balance out" (get rid of) the effect of gravity. Often these are referred to as scales, but that too is technically the wrong word.

There are three types of balances we may use in Chemistry lab:

- Triple Beam Balance - has three arms with sliding masses
- Centigram Balance - has four arms with sliding masses or three arms and a knob
- Electronic Balance - uses no arms and gives a digital readout

In general two methods are used when wanting to mass an object.

1. If the object will not easily break into pieces, then the object is placed directly on the pan of the balance and the sliding masses are moved until the arms are balanced. Then the positions of the sliding masses are added together for the total mass of the object.

Answer questions 1-3 in Section 6 of the Assignment Sheet.

2. If the object is a liquid or a solid that will easily break apart (like a powder) then a holding container (like a beaker or piece of paper) must be used. Find the mass of the empty holding container using the method in #1. Then add the liquid or powder to the holding container, and find the new mass of both the container and the contents, using the method in #1 again. Subtract the mass of the empty container from the mass of both the container and contents, and this will give you the mass of the contents only.

Massing using a container:
Mass of container and contents - mass of empty container = mass of just the contents (liquid or powder)

Be careful that you do not overload (put too much mass on) the balances. This can ruin the calibration of the balance and require costly repair (especially with the electronic balances).

Gather your pencil/pen and a 250 mL beaker. Find the location of all three types of balances. Answer questions 4-8 in Section 6 of the Assignment Sheet.

Section 7: pH Testing

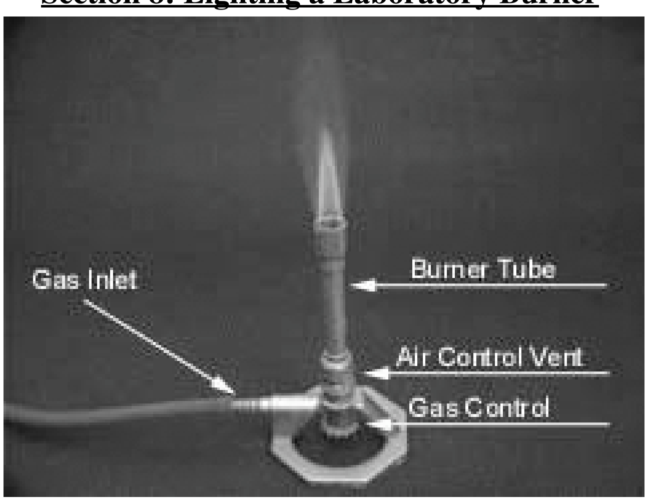
One important part of Chemistry is the ability to identify unknown substances by their reactions. One simple test is to determine if a liquid substance is an acid or base, and how acidic or basic it is. The reason this type of testing is simple is because it involves indicator papers; papers that change colors under specific circumstances.

Litmus paper is one type of indicator paper. It comes in two varieties - blue and red. Red litmus paper turns blue in the presence of a base (blue litmus paper would remain blue). Blue litmus paper turns red in the presence of an acid (red litmus paper would remain red). Unfortunately litmus paper gives no indication of how strong an acid or base the liquid substance is, so we need another way to determine the strength of an acid or base.

pH paper is another type of indicator paper. It is specially designed with multiple color change possibilities that depend on the pH of the liquid substance. pH paper gives an approximation of the strength of the acid or base in reference to the pH scale. The pH scale runs from 0 -14. Acids are at the bottom of the scale (0-7) and bases are at the top of the scale (7-14). A pH of exactly 7 is considered neutral. Strong acids are found in the low numbers (0-3), weak acids are higher on the scale (4-7), weak bases are next on the scale (7-10), and strong bases are found at the top end of the scale (11-14).

Gather two strips of red litmus paper, two strips of blue litmus paper, and two strips of pH paper. Determine the location of the 8 samples. Answer the questions in Section 7 of the Assignment Sheet.

Section 8: Lighting a Laboratory Burner



A laboratory burner (often called a Bunsen Burner, even though they usually are not) is a common tool for heating substances. A laboratory burner is a way to control the combustion of a gas (usually methane) and increase the temperature of the combustion by adding oxygen.

Burners have two movable parts, the burner tube that screws open or closed some air control vents, and a gas control knob on the bottom that adjusts how much gas enters the burner tube.

Steps for lighting a laboratory burner:

1. Check the surrounding area and remove anything that is flammable.
2. Check the rubber tubing for cracks. If it is in good shape, then firmly attach it to the gas jet on the lab desk and the gas inlet of the burner.
3. Twist the burner tube to completely close the air control vents.
4. Close the gas control knob (if looking at the bottom of the burner then "left-loose and right-tight" applies).
5. Reopen the gas control knob to a middle amount of openness.
6. Have your striker or match handy.
7. Turn on the main gas valve at the lab desk. Remember perpendicular means off and parallel means full on.
8. If you can hear the gas coming from the burner, close the gas control knob a little.
9. Try striking the burner. A little pressure on the back of the striker will help make a spark. If you succeed you should get a orange-yellow flame. If you don't succeed, read the problems and solutions section below.

Problems with lighting a burner:

- *There is no spark*. Check the condition of the flint. If it is good, then apply pressure on the back of the striker.
- *There is a spark, but no flame, or a very small flame that blows out*. Open the gas control knob or the main gas jet valve a little more, you may need to open both a little more.
- *There is large flame that seems to float above the burner, and then blows out*. Close the gas control knob a little more.

Adjusting the flame:

Once the burner is lit, then the burner must be adjusted to use it as a heating device. Holding the burner tube NEAR THE BOTTOM, twist open the windows until you get a light blue flame, as seen in the picture on the previous page. You may also need to adjust the gas control knob to make the flame bigger or smaller. Once adjusted as shown, the flame IS VERY HOT. You do not want to pass anything flammable near the flame. The hottest part of the flame is right above the small, bright blue triangular part of the flame called "the inner cone".

When the burner is not being used right away, but will be used in the near future, keep the flame the orange-yellow color so other students in lab can see that it's there and not accidentally get too close to it.

Turning off the burner:

Once the you are finished using the burner, turn off the gas at the main gas valve at the lab desk. Do not immediately touch the burner as it will be hot, especially the top of the burner tube. Let the burner cool for a few minutes before you put it away.

Answer the questions in Section 8 of the Assignment Sheet. When ready have your teacher watch you light the burner and sign Section 8.